DEPARTMENT OF AGRICULTURE AND MARKETING

1990 RESEARCH COMMITTEE REPORT

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RESEARCH COMMITTEE REPORT

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1990

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NOVA SCOTIA DEPARTMENT OF AGRICULTURE AND MARKETING

RESEARCH COMMITTEE

1990

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RESEARCH COMMITTEE REPORT

1990

Introduction:

Agricultural Research in Nova Scotia has made a significant contribution to the growth and development of the agricultural industry in the province.

The Nova Scotia Department of Agriculture and Marketing, including the Nova Scotia Agricultural College, in partnership with other governments, universities and industry, conducts agricultural research to benefit farmers, the agricultural industry, and society.

The development and adoption of new technologies and techniques will lead to a more competitive, viable agricultural industry that is environmentally sensitive and sustainable in the province and in Atlantic Canada.

Agricultural research conducted and funded through provincial research resources forms part of a larger research effort of the Department of Agriculture and Marketing and the Nova Scotia Agricultural College. This report captures the highlights of projects so funded and notes progress accomplished during the 1990 year.

This report is published for the information of research and extension workers, farmers, the agricultural industry, and the general public. More specific and detailed information may be obtained by contacting the author(s) of the specific research project(s).

AGRICULTURAL ENGINEERING

RESEARCH REPORTS

TITLE: **Livestock and Poultry Barn Air Quality**

LEADER: Donald Allen

OBJECTIVE: To examine air quality in selected livestock and poultry barns in Nova Scotia.

To investigate relationships between air quality, ventilation rate, occupants, feeding and manure handling systems.

PROGRESS:

An air quality investigation was conducted in selected livestock and poultry barns in Nova Scotia.

Visits have been made to 40 livestock and poultry barns. The buildings were located in Colchester, Cumberland, Antigonish and Kings counties. Physical measurements,air temperatures and humidity and air quality measurements were taken. Differences in feeding, penning, manure handling and ventilation systems were noted. Visits were made during three ventilation seasons when air flows were typically at a low, medium and maximum rates. Data was collected starting in June of 1990 and ending in March of 1991.

Buildings investigated included 16 poultry, both floor and cage systems, 16 swine and 8 dairy occupancies.

A summary of the air quality data is shown in table 1. Gas levels were measured using a Gastec sampling pump and tubes. Dust concentrations were determined with a TSI piezobalance using a 3.5 micron impactor which allowed 50% of the dust particles over this size to bypass the measuring plate.

It is clear that the dairy buildings examined were operating within acceptable air quality ranges and will no longer be considered for this survey. The results of the measurements taken in the swine and poultry buildings show that some of these occupancies experience gas levels at or above suggested threshold levels and will be further examined.

Report sheets are being prepared and will be sent to each cooperating farmer showing the data collected at his building and comparing it to the suggested operating range or threshold.

Further work will be done to investigate the variance with space and time at the buildings identified as having higher gas levels on the initial survey. Factors which may improve air quality will be considered.

Table 1 Swine, Poultry, and Dairy Barn Measurements. Summary of Measurements

1 Low Ventilation Season

Parameter		Swine	Poultry	Dairy
Ammonia (p.p.m.)	High	30	30	11
	Low	7.00	2.00	2.00
	Average	18.88	12.33	6.16
Carbon Dioxide (p.p.m.)	High	3800	3000	2300
	Low	2300	500	750
	Average	2725.00	2630.00	1537.50
Dust (mg/m ^ 3)	High	0.75	2.3	0.15
	Low	0.15	0.07	0.03
	Average	0.37	0.61	0.07

2 Medium Ventilation Season

Parameter		Swine	Poultry
Ammonia (p.p.m.)	High	30	15
	Low	2	0.75
	Average	10.77	6.61
Carbon Dioxide (p.p.m.)	High	3500	1700
	Low	500	400
	Average	1411.54	986.36
Dust (mg/m ^ 3)	High	0.91	0.8
	Low	0.05	0.02
	Average	0.23	0.16

3 High Ventilation Season

Parameter		Swine	Poultry
Ammonia (p.p.m.)	High	10	20
	Low	2	2
	Average	5.37	6.86
Carbon Dioxide (p.p.m.)	High	1500	1500
	Low	550	400
	Average	850.00	827.27
Dust (mg/m ^ 3)	High	0.16	0.67
	Low	0.06	0.03
	Average	0.11	0.21

TITLE: **Low Temperature Bath with Programmable Control**

LEADER: Peter Havard

OBJECTIVE:

a) Design of programmable temperature controlled bath.
b) Construction of unit.
c) Testing and program development.

PROGRESS:

The construction of the low temperature bath unit was completed in the summer of 1990. The unit was tested and is able to control the refrigeration and heating systems for a ethanol bath in the temperature range of -30°C to + 30°C. The unit can cycle through a series of set points or perform a single series. All controls and monitoring of temperatures are performed by a PC computer. Collected data is in a format suitable for Lotus 123. Maximum cooling and heating rates varied between 2/3 to 1°C/min. for the 8 gallons of ethanol in the bath. An aerator using ethanol vapour maintained a uniform temperature throughout the tank. The unit has a built-in test tube holder for 186-25 mm test tubes.

Plant Science Department has done several tests subjecting plant material to a freezing cycle. The temperature both provided suitable temperatures, records of temperatures, large capacity in an automated manner to meet their requirements.

Several trial runs using plant breeding from Plant Science has demonstrated this machine's value in research over past methods.

Future improvements include: PID control algorithms in the software; better temperature measurement accuracy by switch to RTD temperature probes from thermocouples and collaboration with interested researchers on studies where low temperature application is useful.

TITLE: Irrigation Scheduling with Norchip Potatoes

LEADER: Ali Madani

OBJECTIVE: To evaluate a variety of existing irrigation scheduling methods based on monitoring leaf water potential, soil moisture potential, and soil moisture content.

PROGRESS:

The overall objective of this study is to evaluate a variety of existing irrigation scheduling methods for potatoes based on monitoring leaf water potential, soil moisture content and soil moisture potential.

The irrigation scheduling treatments decided by consensus of the project team were 30%, 40%, and 50% depletion of available soil water (A.W.), and a control. An arrangement of 4 replications of the 4 treatments was laid out on the field, in a randomized complete block design.

In June plots of four rows were seeded to Norchip variety. Prior to crop emergence, a Neutron probe access tube was installed to a depth of 80 cm in each plot in the center of one of the inner rows to measure soil moisture content. To correlate the moisture content of the soil to its water potential, a tensiometer was also installed near each access tube.

Readings of soil moisture, leaf water potential, soil water potential and leaf temperature were taken for each plot, on each morning that irrigation water might be required. Table 1 shows the amount of irrigation water applied throughout the growing season for each treatment.

TABLE 1

TREATMENT	NUMBER OF IRRIGATIONS	TOTAL WATER APPLIED, mm	RAINFALL mm *
30% A.W.D.**	7	194	279
40% A.W.D.	5	166	279
50% A.W.D.	4	142	279

* Total Rainfall from June 01 to September 28 (harvest date)
** A.W.D. - Available Water Depletion

Preliminary data indicate that the highest yields of Canada No. 1 Grade potatoes was harvested from the 40% A.W. plots, followed by 50% and 30% respectively. The variation in yields amongst the irrigation treatment was not statistically significant, however, the weather data for the summer of 1990 indicate that the potato crop was never under significant moisture stress. It should be noted though, that there is a noticeable yield difference between the 40% A.W. plots and the control plots. Further activity on this project is needed to enable the acquisition of more meaningful soil and plant moisture data, and their relation to crop yield under moisture stress conditions.

TITLE: Subsurface Drainage Survey

LEADER: Ali Madani

OBJECTIVE: To investigate the level of satisfaction of the farmers with their subsurface drainage systems.

PROGRESS:

During the ten years 1977-1986 alone, over six and one half million metres of tile drains have been installed in Nova Scotia. Yet, little information has been documented concerning the effectiveness of the systems from the point of view of the Nova Scotia farmers.

With the significant investment by the federal and provincial governments in subsurface drainage installations, it seems reasonable that some feed-back in practical terms from the perspective of the farm community would be in order.

The purpose of this is, therefore, to investigate the level of satisfaction of the farmers who have taken advantage of the land improvement assistance programs of the Nova Scotia Department of Agriculture and Marketing for sub-surface drainage installations.

In order to achieve the objective of this study, a comprehensive questionnaire was developed with the help of the Extension Engineering Division of the Department and Ms. Lauranne Sanderson, Professor of Humanities, N.S.A.C. This questionnaire was tested by randomly selecting 25 clients from the files of the Extension Engineering division. The completed questionnaires which were returned were assessed and it was improved accordingly.

In late February 1991, a total of 580 questionnaires were mailed to farmers who had previously been identified as land improvement program clients. To date 250 questionnaires have been returned and more are expected. The preliminary returns have indicated that not all of the clients to whom questionnaires were directed had actually installed sub-surface drainage systems but had done other land improvements projects.

By late spring the questionnaires returned will be statistically analyzed and a comprehensive report will be generated by a senior Agricultural Mechanization student. It is hoped that the results obtained from the survey will identify new areas of required research into the installation and performance of sub-surface drainage system in Nova Scotia.

TITLE: **Effect of Head Speed Ground Speed Ratio on Picking Effectiveness of a Lowbush Blueberry Harvester**

LEADER: Kevin J. Sibley

OBJECTIVE: To determine the effects of head speed ground speed ratio on the picking effectiveness of a lowbush blueberry. To develop optimum head speed ground speed ratio ranges to suit various crop conditions.

PROGRESS:

During the summer of 1990, an electronic speed monitoring system was installed on a Bragg lowbush blueberry harvester. A 3 x 3 factorial field experiment replicated six times was used to collect data on picking performance at various head speed to ground speed ratio's (HSGSR's). Forward speeds of 1.6, 2.1 and 2.5 km/hr and HSGSR's of 1.4, 1.5 and 1.6 were used. Data on pre-harvest losses, yield, and machine picking losses were gathered at one site in Debert, Nova Scotia. Data on hand raking picking losses was also gathered for comparison purposes. On a smooth field having bushes 15 to 20 cm in height and a yield of 9,940-kg/ha, machine picking losses averaged between 6.9 and 18.6% by weight depending on the HSGSR-Forward speed combination. Pre-harvest losses averaged 6.5% by weight. Hand harvest losses averaged 12% by weight. Data for other crop conditions will be gathered during the 1991 season.

ANIMAL SCIENCE

RESEARCH REPORTS

TITLE: **Effect of Water Quality on Nutrient Availability for Grower Finisher Pigs**

LEADER: Derek M. Anderson

OBJECTIVE: To determine the effects of increasing levels of total dissolved solids (in the form of sodium salts or sulphates) in water on the partitioning of nutrients from the diet of grower to finisher pigs.

PROGRESS:

Two 6 x 6 latin square experiments were conducted with male Yorkshire pigs. The first experiment consisted of water treatments that contained 0 (distilled water), 350 (tap water), 1000,4000, 6300, and 8000 ppm total dissolved solids (TDS). High TDS were obtained by the addition of sodium bicarbonate, sodium chloride, and sodium sulphate (in the ratio of 3:3:1) to tap water. At these levels, no significant effect on metabolizable crude protein, digestible energy, digestible crude protein or growth rate occurred. Water treatments had a significant effect ($P<0.05$) on metabolizable energy. Water intake was 9.0 $L.d^{-1}$ at 8000 ppm TDS compared to 7.0 $L.d^{-1}$ for 6300 ppm TDS. Urinary output was significantly higher on the water treatment with 8000 ppm TDS at 6.9 $L.d^{-1}$.

In the second experiment, 6 water treatments were prepared by the addition of magnesium sulphate, sodium sulphate, and sodium chloride in the ratio of 3:3:1 to tap water (450 ppm TDS) to obtain water containing 1100, 4000, 7000, and 11700 ppm TDS. Distilled water (0 ppm TDS) and tap water (450 ppm TDS) were the other water treatments used. No significant effects on water intake, urinary output, growth rate or digestibility of crude protein, energy or dry matter were observed. Pigs provided with the 11700 ppm TDS water treatment suffered from mild diarrhoea.

With respect to digestibility of energy containing nutrients, the increasing levels of TDS in water appeared to have little effect.

TITLE: **Herring By-product for Mink**

LEADER: Derek M. Anderson

OBJECTIVE: To evaluate the thiamine status of mink by the use of transketolase. To evaluate herring by-product in mink diets.

PROGRESS:

Transketolase analysis of mink blood was not found to be an effective measure of thiamin status. Procedural problems associated with the analytical technique used failed to give repeatable levels of transketolase. The blood samples were frozen prior to analysis. Although the freezing was thought to be the cause of the problem with analysis, fresh blood samples failed to provide acceptable analysis reliability. The procedure used could not be used to measure thiamin status of mink fed diets containing fish known to contain thiaminase.

TITLE: **Animal Evaluation of Forage Quality**

LEADER: L. M. Cock

OBJECTIVE: To measure and demonstrate the effects of forage of:

1. Stage of maturity at cutting
2. Harvesting losses
3. The interrelationships of these two factors and weather

PROGRESS:

Forages were harvested in the summer of 1989. Grass (old sward) and legume (alfalfa-timothy seeded 1988) crops were cut at early (boot/bud stage) and late (head/flower stage). Storage was with conventional machinery, as haylage (40% D.M.), as mow-dried hay (65% D.M.), and as field-dried hay (80% D.M.). One grass haylage (2nd crop boot stage) became dryer than scheduled (55% D.M.).

Intakes and digestibilities of silages by sheep were reported in the 1989 report. In the summer of 1990, intakes of hays and silages were measured with yearling steers, resulting in the following:

ANALYSES AND CONSUMPTIONS OF FORAGE

FORAGE type	FORAGE storage	PROTEIN %	ADF %	CONSUMPTION % of body weight
1st crop grass/boot	hay	13.0	33.1	1.72
	silage	11.9	37.6	2.13
2nd crop grass/boot	hay	13.8	28.7	2.00
	silage	12.6	33.2	1.80
Legume/bud	hay	15.7	34.2	2.00
	silage	15.3	35.3	1.73
Legume/flower	hay	11.5	34.3	0.82
	silage	11.7	39.7	1.07

The only significant effect of crop on consumption by steers was the depressed intake of the mature legume, either as silage or hay. In the sheep trials, this depression of intake was not noted and although dry matter digestibility was lowest for this forage (56.2%), it was still an average value and would not explain this depression with steers.

The effect of harvesting method was studied, through a comparison of the chemical compositions. It can be noted that the fibre content of the silages is consistently higher than the hays, and the protein contents of the silages is lower or equal to the hays. This is in contradiction of the literature which suggests more leaf loss in handling the dryer forage resulting in higher protein and lower fibre in silages.

TITLE: **Absorption of Calcium from Alfalfa/Timothy Mixed Forage**

LEADER: Alan Fredeen

OBJECTIVE: High concentrations of dietary potassium and calcium are suspected of interfering with calcium metabolism. Fertilization with potassium, increases forage potassium concentrations. The objective of this research was to examine the effect of high dietary potassium and calcium on the kinetics of calcium metabolism.

PROGRESS:

Six mature sheep were randomly allocated to one of two diets containing either high (4%) or low (2%) levels of potassium. Calcium intake was maintained at 8.6 g $^{d-1}$. The experiment consisted of two periods, each 21 d, comprised of a 14 d adjustment and 7 d of intensive sampling following an intravenous injection of ^{45}calcium. Sheep were switched to the other diet and the sequence was repeated. Blood, fecal and urinary samples were analyzed for radiotracer and total concentration of calcium. A radiotracer dilution technique was used to estimate effects of treatment on the kinetics of calcium metabolism.

Results are shown in Table 1. Although no differences are significant ($P > 0.05$), trends suggest that a dietary level of potassium as low as 4% may have negative effects on the ability of cows to respond to the sudden calcium loss that accompanies parturition. This has implications for fertilization recommendations.

Table 1. Effect of level of dietary potassium on calcium absorption, bone calcium absorption and size of the exchangeable calcium pool

Item	Low K	High K	SEM
Calcium absorption, g d^{-1}	1.45	1.14	0.32
Bone calcium resorption, g d^{-1}	-0.54	-0.25	0.32
Size of exchangeable calcium pool, g	12.19	8.80	2.73

TITLE: **Development of a Novel Technique to Estimate Body Lipid Content**

LEADER: Alan Fredeen

OBJECTIVE: No technique currently exists for the direct determination of body fat in live animals. If such a technique existed, it could be used to establish nutritional and genetic regimes that would result in optimal body fat levels in cows at various stages of lactation. The objective of the research was to develop a novel technique for the estimation of body fat in vivo for application in dairy cow studies.

PROGRESS:

Various markers have been screened and suitable markers have been identified. Rats were injected with marker, and samples of blood and adipose tissue were sampled and analyzed for marker concentration. Techniques were developed for analysis of marker concentration. The research has progressed to a stage where an experiment can be conducted.

TITLE: **Effect of Diet on Adipose Tissue Metabolism in Dairy Cows**

LEADER: Alan Fredeen

OBJECTIVE: Body fat reserves of cows are an important source of energy in early lactation. Almost no research has been conducted to determine how feeding management effects the ability to mobilize body fat. With more cows finishing their lactations in poor condition, the effect of fattening during the dry period needs to be studied. The objective of this research was to study body fat content and fat metabolism in cows as they progress through their lactation. Effect of fattening cows slowly during late lactation versus quickly during the dry period on the ability to mobilize body fat will be examined.

PROGRESS:

A batch-calving group of about 20 cows has been established in the N.S.A.C. dairy herd, to be used in this project. A body condition scoring system has been adapted to our conditions and these cows have been condition-scored monthly by a team, since before their calving. The condition of cows will be monitored until they are close to drying off. Two groups will be established, based on condition; one group will be fattened to a uniform score of 4.0 before calving. Techniques are being developed to estimate total body fatness in vivo, and to measure lipolytic rates in tissue slices. These techniques will be employed to study effect of condition (dietary regime) at calving on lactational performance.

TITLE: **Effect of Enzymes on the Nutritional Value of Silage**

LEADER: Alan Fredeen

OBJECTIVE: Commercial enzyme additives for silages that digest cellulose, hemicellulose and starch in forages are being marketed in the U.S. Their efficacy is unknown, especially under ensiling conditions encountered in Atlantic Canada. The objective of the study was to examine the effect of enzymes on the nutritional quality of first and second-cut alfalfa/timothy forage.

PROGRESS:

First and second-cut alfalfa/timothy forages were wilted to 35% dry matter and ensiled untreated (control) or treated with one of two commercial enzyme products (Cultor, formerly Finnsugar Biochemicals Inc., Finland). Alfazyme consisted of a mixture of cellulase, amylase, glucose oxidase and lactic acid bacteria; Grasszyme was similar, but lacked amylase. Silages were fed in two trials to 9 lactating dairy cows each, in a repeated 3x3 Latin square design with 28 day periods, 60 (second cut) and 120 (first cut) days post-ensiling. Second-cut silage was also fed to six sheep in a repeated 3x3 digestibility trial (21 day periods) to determine the effect of enzyme preparations on digestibility of fiber.

First-cut silage was similar quantitatively across treatments. Concentration of water soluble carbohydrate was higher ($P<0.05$) in Alfazyme treated second-cut silage than in Grasszyme or control silages, but otherwise, silages were similar. Performance of cows was not affected by treatment of first-cut forage. Cows fed Alfazyme treated second-cut silage tended to consume more dry matter ($P=0.09$) and had lower ($P<0.05$) milk fat concentration. Sheep consumed more forage ($P<0.01$) treated with Alfazyme, and dry matter digestibility was higher ($P=0.09$) in this group compared with the control.

TITLE: **Investigation of the Efficacy of Parabiologicals in the Prevention and Cure of Mastitis in Commercial Dairy Farms**

LEADER: Alan Fredeen

OBJECTIVE: Parabiologicals are extremely dilute preparations of mastitis-causing bacteria that have been reported to prevent and cure mastitis, based on a principle similar to homeopathy. No independent research has been conducted on the material. A trial was initiated, on the request of the dairy community, to examine the efficacy of parabiologicals.

PROGRESS:

Three dairy fairs were selected for a field trial to examine the efficacy of parabiologicals in preventing and curing mastitis during the dry period, and curing clinical mastitis during lactation. Cows were allocated to one of two groups, two months before drying-off. The control group was dry-treated with antibiotics, and clinical cases of mastitis were treated with antibiotics. An untreated control group was not attempted because of possible risk to the cows. The parabiologic group was treated with a semi-autogenous parabiologic preparation, at drying-off, at calving and when clinical cases occurred. Table 1 shows the results of the study to date. Statistical analysis has not been conducted, but parabiologicals appear to be as effective as antibiotics in curing mastitis under the conditions of this experiment.

Table 1. Effect of parabiologics on the prevention and cure of mastitis in commercial dairy herds (preliminary data)*

Item	Antibiotic (Control)	Parabiologic
Total no. cows	90	87
Cows that calved with mastitis:		
-subclinical	12	21
-clinical	1 (coliform-cured)	5 (Strep. dys-cured) (coliform-cured) (Act. pyog.-cured) (Act. pyog.-nc) (unknown-cured)
Cows with clinical mastitis during lactation:	2 (coliform-cured) (unknown-cured)	3 (Strep. dys-cured) (Staph. aur-cured) (Act.pyog.-cured)

*Cured refers to disappearance of clinical symptoms and infecting bacteria within one week; nc=not cured.

TITLE: **Measurement and Reduction of Stress in Farmed Mink**

LEADER: Alex W.L. Hawley

OBJECTIVE: To evaluate the stress imposed on mink as a result of catching and restraining the animals with a cylinder restraint device.

PROGRESS:

During the fall, 1990, 20 male and 20 female mink were used to compare handling efficiency and animal response between two handling methods. One method involved capture and restraint by hand and the other capture and restraint using a newly developed cylinder device designed for this purpose.

It took less time for an experienced mink handler to catch the animals by hand than with the cylinder, but it was easier and less fatiguing to restrain animals in the cylinder once they were caught. Capture time with the cylinder was much less for someone experienced with use of the device. In addition, the design of mink pens at the NSAC, where the study was conducted, was not conducive to efficient use of the cylinder. It was concluded that the cylinder could increase efficiency of handling mink for inexperienced handlers or if pens were designed to accommodate their use. Using the cylinder would reduce fatigue for all handlers if large numbers of mink were to be restrained.

Preliminary analysis disclosed no differences between handling methods in the mean concentrations of blood cortisol, eosinophyls or urinary cortisol. Animals restrained by hand displayed a higher neutrophyl:lymphocyte ratio ($P < 0.05$), suggesting that these animals experienced greater stress. However, not all hormonal analyses are completed at this time, and all conclusions must be considered preliminary. It was concluded from this preliminary analysis that no biologically significant difference in stress level could be demonstrated between the two handling methods. Thus, information to date indicates that the cylinders could be recommended for use by producers.

FUTURE RESEARCH: Hormonal analyses will be completed and the data subjected to final analysis. Modification of the design and construction of the cylinder device will continue in order to improve its efficiency of use. Further research is proposed investigating alternative means of relating animal stress to management alternatives.

TITLE: **Study of the Possibility of Introducing Edible Land Snail Production in Nova Scotia**

LEADER: Andre Lirette

OBJECTIVE: 1st Year of Two:
- Study nutritional preferences of edible land snails.
- Study survival under Nova Scotia summer climatic conditions
- Study weight gains during summer

OVERALL OBJECTIVE:
Study the possibility to introduce edible land snail production into Nova Scotia.

PROGRESS 1st YEAR:

One thousand two hundred and fifty (1,250) land snails were divided randomly between 25, 1.5m x 0.9m x 1.5m cages, wrapped in a nylon screen and chicken wire to prevent the snails from escaping and protect them from predators. The cages were placed in a shaded area of an outside field and randomly divided into 5 nutritional treatments with each treatment replicate 5 times. The snails were fed with natural vegetation, lettuce and oyster shells, lettuce alone, oat bran, and white clover in treatments 1,2,3,4 and 5 respectively. The experimental design was completely randomized. The snails in each cage were weighed and counted every two weeks. A digestibility trial on lettuce and white clover was also done. The snails gained significantly ($P<0.05$) more weight when fed with the lettuce and lettuce plus oyster shells than the other treatments. The weight gains for the white clover and natural vegetation were intermediate among the diets. The death rate was approximately 5.1% $\pm$ 0.3% in each treatment with the exception of the oat bran diet which produced significantly ($P>0.01$) more deaths (66% $\pm$ 5%). The digestibilities of lettuce and white clover were 17.5 $\pm$ 0.3% and 16.9 $\pm$ 0.5% respectively and were not significantly different ($P>0.05$). It was concluded that edible land snails can be raised outside during the summer under the environmental conditions of Nova Scotia if fed with diets 1,2,3 and 5.

TITLE: **Swine Conformation and Relation to Carcass Composition**

LEADER: D. L. Patterson

OBJECTIVE: 1) to predict swine carcass composition from live animal measurements and video image analysis
2) to assess the value of video image analysis in animal conformation studies
(Completion of the program begun in 1989)

PROGRESS:

Prediction of lean yield of a carcass from live animal measurements can reduce the need for progeny or sib testing in selecting breeding stock. Ultrasonic backfat measurements are very useful, but coupling these with other measurements of body size could improve accuracy of assessment. With this in mind, a study on swine conformation was carried out by M. Savard as part of the requirements for her M.Sc. degree.

A total of 103 purebred Yorkshire pigs (49 barrows and 53 gilts) were measured and videotaped at three different ages. The videotapes were digitized using a Bioquant™ Image Analysis System (R&M Biometrics Ltd., TN), and the same measurements as those taken on the live animal were made. After slaughter at approximately 100 kg, one half of each of 59 carcasses were measured for fat thickness and length at various locations, and the carcass videotaped for image analysis. Each carcass was physically dissected into four wholesale untrimmed cuts.

Measurements taken were very repeatable, with repeatabilities ranging from 0.83 to 0.98 for physical measurements, and 0.86 to 0.99 for image analysis measurements. Correlations between live pig measurements and similar measurements from the videotapes were low for weaner and finisher pigs (0.12 to 0.56), but somewhat higher for feeder pigs (0.30 to 0.50). These low correlations may be partly due to movement of the pig during measurement, and to difficulties in placing accurate scale markings on the animals, and can perhaps be overcome by taking measurements on several video frames rather than on just one.

With the exception of one backfat measurement, correlations between actual and video carcass measurements ranged from 0.46 to 0.84. Live animal ultrasonic backfat thickness and body weight by themselves accounted for only small proportions of the variation in wholesale cut percentages. When other body measurements such as shoulder and ham widths were added to the equations, the proportion of variation explained was improved. The accuracy of predicting percent wholesale cuts from measurements was similar for both actual carcass values and image analysis techniques. These results indicate that video image analysis techniques can be useful in evaluating carcass composition, although it may be necessary to use a true colour system to obtain the best resolution of fat and bone.

This project was presented at the Joint Meeting of the Eastern Branches of CSAS, ADSA, ASAS, in Chazy, New York, July, 1990. Ms. Savard completed her M.Sc. degree in October, 1990.

TITLE: **Video Image Analysis in Assessing Pork Cut Composition**

LEADER: D.L. Patterson

OBJECTIVE: To examine the use of a video image analysis system to evaluate amount of lean, fat and bone in pork carcasses.

PROGRESS:

Video image analysis systems have potential in assessing the quality and composition of animal carcasses. At present, physical dissection and/or chemical analysis is used to determine proportions of muscle, fat and bone in carcass evaluation studies. However, such techniques are time-consuming, costly, and result in loss of the carcass value. Videotaped views of the carcass or meat cuts can be digitized via an image analysis system very rapidly, and without destroying the value of the cut. If the amount of each component tissue can be estimated with accuracy, this technique could substitute for physical dissection of meat cuts.

Untrimmed wholesale cuts of pork were obtained through the NSAC Meat Lab. To date 9 loin cuts, 10 shoulder butts,10 shoulder picnics, and 7 hams have been examined, with three cuts more to be done. Each cut was videotaped from each side and from each corner angle, and acetate tracings were made of each side. The cut was then physically dissected into muscle, bone,subcutaneous fat (SC Fat), and intermuscular plus body cavity fat (IM Fat). Each videotape and tracing was digitized using the Bioquant™ image analysis system, and the amount of muscle, fat and bone showing in each view was determined. Percentages of component tissues obtained in physical dissections are as follows. (Percentages do not add to 100% because of rounding.)

Cut	Average Weight	Percentage			
	kg.	Bone	SC Fat	IM Fat	Muscle
Loin	4.1	19.3	29.9	8.1	44.3
Shoulder Butt	4.1	8.6	12.1	12.2	61.5
Shoulder Picnic	4.0	14.1	9.9	10.8	62.4
Ham	9.7	12.8	11.7	4.6	65.3

The digitized values from the tracings and videotapes will be correlated to the physical dissection measurements. This requires using geometrical principles to calculate the amount of component tissue in the pork cut volume from the external linear and area measurements of each cut surface. It is anticipated that this work will be completed by August, 1991.

TITLE: **Effects of Previous Grazing Experience on the Grazing Behaviour of Lambs**

LEADER: Tarjei Tennessen

OBJECTIVE: To evaluate the effects of a controlled grazing experience before or during weaning on forage preferences of weaned lambs.

PROGRESS:

Forty lambs with their dams were exposed to either white clover (WC) or ryegrass (RG) pastures for 7 days, 1 h/d, at either 14 wk or 19 wk (during weaning) of age. This constituted the sole grazing experience of the lambs. Ten lambs not exposed to pasture comprised the control group. During the 4th wk after weaning, each animal was tested for 5 days, 30 min/d, on a pasture containing both WC and RG in alternating strips. The lambs were tested in pairs and each pair was treated as an experimental unit. Whether the lamb was grazing or not and the forage being grazed were recorded every 20 s. Overall results showed that pasture-experienced lambs showed longer grazing bouts ($P < 0.01$) and grazed for almost twice as long (192%) as did control lambs ($P < 0.01$). WC-experienced lambs spent a higher ($P < 0.05$) proportion of their grazing time on WC strips than did RG-experienced lambs (69% vs 45% of the total grazing). Lambs exposed to pasture at different ages did not differ ($P > 0.05$) in pasture acceptance or forage preferences. We conclude that giving unweaned lambs a short grazing experience, in the presence of their dams, can increase both the initial acceptance of pasture and preference for a certain type of forage after weaning.

TITLE: **Space use by Stall Housed Calves**

LEADER: Tarjei Tennessen

OBJECTIVE: To assess the amount of space required by veal calves to groom and rest comfortably.

PROGRESS:

Reaching a consensus on the minimal space requirements of individually or group penned livestock has not been an easy task. At the very minimum, a stall must allow an animal to stretch, groom, and adopt comfort resting positions. Video image analysis is a flexible tool for freely measuring the space taken up by animals during normal movements. AT NSAC, we have used the technique (Bioquant Image Analysis System) to evaluate the adequacy of current dimensions of veal calf crates. At present, 27 dairy calves have been measured from age 3 days to 4 months. At 4 months and an average weight of 135 kg, lying width was 60.1 $\pm$ 8.1 cm, width with head turned back was 60.3 $\pm$ 8.1 cm, and width while grooming was 62.8 $\pm$ 3.1 cm, and width while grooming 62.8 $\pm$ 3.1 cm. Agriculture Canada's 1988 Code of Practice for the Care and Handling of Special Fed Veal Calves, recommends a stall width of 65 cm for calves up to 200 kg. The present study suggests that 65 cm may not be sufficient for calves near the upper weight limit to freely adopt comfort resting positions or groom.

BIOLOGY

RESEARCH REPORTS

TITLE: **Effects of Herbicides and Fertilizers on Blueberries**

LEADER: Dr. Leonard J. Eaton

OBJECTIVE: To assess the effects of herbicides and fertilizers on vegetative and reproductive growth, and on yields of lowbush blueberries.

PROGRESS:

Four treatments, control, herbicide, herbicide + ammonium nitrate and herbicide + NPK (1-1-1 ratio) were initiated in 1979 and repeated every second year. N was applied at the rate of 56 kg ha^{-1}. Total stem lengths, dry weights, fruit buds and yields were assessed during each two-year cycle. During 1990, 100 stems per plot were tagged, and counts of buds, blossoms, fruit set and berries were taken at appropriate times.

Over the long-term study, all the treatments resulted in greater total length and dry weights of vegetative stems, more fruit buds and higher fresh fruit yields than did the controls, but only after six year (3 cycles). Yields from herbicide only plots were similar to those from herbicide + fertilizer plots; suggesting that fertilizers may not stimulate yields beyond those obtained with herbicide only. It appears that phosphorus may stimulate yields, but the differences were not consistent.

In April and May 1990, all treated plots had significantly more fruit buds and blossoms/stem than did control plots, suggesting that the treatments stimulated yield potential. The bud counts in herbicide + NPK plots were higher than those in herbicide and herbicide + ammonium nitrate plots. The drop in fruit set of treated plots suggests that pollination may be a problem where herbicides and fertilizers are used. The final yield, in berries/stem was approximately one third of the original number of blossoms per stem in all treatments, and was approximately the same as the number of fruit buds in April. The actual decrease in berry number from fruit set to harvest was greater in treated than in control plots. It is possible that the plants may not be able to sustain some of the increased yield potential made by use of herbicides and fertilizers.

TITLE: **Collar Rot of Apple Trees**

LEADER: A. Bruce Gray

OBJECTIVE: To develop an in vitro method to evaluate apple rootstock for reaction to Phytophthora cactorum.

PROGRESS:

The host-pathogen relationship between apple (Malus) rootstock and Phytophthora cactorum (Lebert & Cohn) Schroeter, was examined in vitro. P. cactorum is the fungal pathogen that causes collar rot in apple trees in most apple-producing regions in the world. Callus tissue derived from resistant and susceptible rootstock was inoculated with the pathogen and a differential response was observed. The basis of this response is hypersensitive in nature, and the morphology of the callus is of primary importance in obtaining this particular expression of resistance. Two morphological forms of the resistant M4 callus, the tight callus, and the tight-budding callus, underwent a hypersensitive response to inoculation with associated reduction in mycelial growth; a third, loose-friable form of the resistant M4 callus did not response in this way. Loose-friable callus tissue derived from the susceptible MM106 rootstock sustained greater mycelial coverage than the callus from the resistant variety. There was no hypersensitive response in this callus. Sporulation occurred on tight-budding and tight resistant callus, but not on the loose-friable resistant or the susceptible callus. The differential response occurred in both secondary and primary callus, but was more pronounced in the former. Primary resistant and susceptible calli grown on media supplemented with 2,4-dichlorophenoxyacetic acid (2,4-D) without a cytokinin was more similar in morphology than calli grown on media supplemented with 1-naphthylacetic acid (NAA) and benzyladenine (BA). Differences in the morphology of the mycelium corresponded to differences in the response to infection. Sporulation occurred on tight-budding and tight resistant callus but not on loose-friable resistant callus or susceptible callus. No sporulation was observed on resistant or susceptible callus cultured on media with 2,4-dichlorophenoxyacetic acid without a cytokinin. Intercellular mycelium was observed in all interactions but was more difficult to locate in the primary resistant callus tissue and the susceptible callus tissue. The spores were not easily found in the susceptible MM106 callus. Haustoria were observed in the resistant M4 secondary callus. On no medium was the morphology of the callus tissue from both varieties the same. Because of the importance of callus morphology in obtaining the expression of resistance, it cannot be concluded that the response of the callus was solely the expression of the genotype of the mother plant.

TITLE: **Atrazine Movement in Soil**

LEADER: M. Glen Sampson

OBJECTIVE: To evaluate atrazine movement in soil during the season with varying corn population and with inorganic vs organic fertilizer and to assess the need for atrazine for weed control in corn systems relying on organic fertilizers such as in sustainable systems.

PROGRESS:

Atrazine is the major herbicide used for corn weed control. Problems have occurred with atrazine movement into ground water, particularly in areas where atrazine is used most intensively. Atrazine has also been identified in a number of wells in Nova Scotia, although at low levels. Studies on field evaluation of pesticide leaching losses have been lacking. With continued use of this and other triazine herbicides, ways must be found to prevent this leaching. In this study, two possible mechanisms were evaluated to reduce herbicide movement: organic matter which can bind the herbicide and plant population which may prevent leaching by uptake or binding of the herbicide to the roots. An experiment with four replicates was set up in a sandy loam soil (organic matter 5.1%). The two plant populations were 87,000 plants ha^{-1} and 131,000 plants ha^{-1}. Each population was subdivided into three organic fertilizer treatments: no manure, 40 tonne ha^{-1} and 80 tonne ha^{-1}. Three soil cores of 16 cm PVC pipe were randomly placed in plots between the corn rows prior to herbicide application. One core was removed prior to herbicide application as a check. The herbicide atrazine was applied post-emergent at a rate of 2.5 kg ai/ha^{-1}. The same day, the first 10 cm depth of soil was sampled with a stainless steel soil core of 7.5 cm in diameter x 10 cm in length. Two cores were taken per plot. Soil cores between the rows were removed on August 21 and November 24. At the same time, two cores were collected randomly from between plants on the row of the crop. Soil samples were frozen after collection until methanol extraction of the herbicide could be done. There was no difference in weed control between any fertilizer or plant population treatments. Weed control lasted longer in the plots receiving organic fertilizer indicating that the herbicide was more persistent in these treatments. A bioassay involving chlorophyll fluorescence was utilized to detect atrazine residues. However, it was found that this method was not sensitive enough to detect the residues. Other more accurate methods were being evaluated but funding was not renewed for 1991 and results remain inconclusive.

TITLE: **Herbicide-pathogen Interactions in Quackgrass**

LEADER: M. G. Sampson

OBJECTIVE:

(a) To identify variation in susceptibility to herbicides between clones of quackgrass.

(b) To identify specific clones of quackgrass utilizing isoelectric focusing.

(c) To evaluate the potential of pathogens used alone and in combination with herbicides on control of quackgrass and the effect of these pathogens on herbicide efficacy.

PROGRESS:

Greenhouse studies indicated that there is naturally occurring variation between clones of quackgrass in response to the herbicides glyphosate and sethoxydim. This variation is present within clones collected from within specific fields and also in fields that may have never been sprayed with these herbicides. These clones can be collected and easily propagated in the greenhouse for use in future trials.

Repeat of trials conducted by spraying amino acids onto plants sprayed with glyphosate confirmed results obtained in 1989. The amino acids phenylalanine, tyrosine and tryptophan could not act as antidotes for glyphosate. These amino acids protected the plants from damage from this herbicide. There were differences between clones in what amino acid protected them. One was protected by the addition of phenylalanine while others required both phenylalanine and tyrosine. These results demonstrate that the mode of action of glyophosate is by inhibition of the aromatic amino acids and confirms that there may be a biochemical basis to the tolerance to glyphosate in various clones of quackgrass.

Isoelectric focusing demonstrated differences between clones of quackgrass in protein bands found. There was an additional band present from a clone of quackgrass that showed tolerance to glyphosate. This band was not present in the protein patterns of the susceptible clones. This adds support to the biochemical basis to tolerance to herbicides in quackgrass and preliminary information indicating that it may be under direct genetic control.

Studies indicated that there was also variability between clones in response to two isolates of the pathogen Cochliobolus sativus. The susceptibility of the clones also differed between isolates. This type of variability is important to consider when looking at pathogens as mycoherbicides. Significant variation between clones to a pathogen can be detrimental to the use of that pathogen as a mycoherbicide.

Results of this study were presented at the Quackgrass Action Committee Meeting, Oct. 25, 1990 in London, Ont.

TITLE: Bacterial bioassay for mycotoxins in grain.

LEADER: G.W. Stratton

OBJECTIVE: To test the suitability of using the Microtox® automated bioassay system for screening grain extracts for the presence of toxicants, such as mycotoxins.

PROGRESS:

The Microtox® bioassay system is based upon a bacterial bioluminescence test, in which a bacterial culture capable of bioluminescence is challenged with various concentrations of a toxicant and any loss in the ability to produce light is measured and quantitated in the Microtox® instrument. The more toxic the compound, the greater the decrease in light output. This test is widely employed in environmental toxicity testing of aquatic, soil, and sediment samples but has not been extensively used with foods. It is a rapid screening test used to identify toxic samples that are then subjected to other tests capable of identifying and quantitating the toxicant(s) present.

With grains, the two candidates for screening tests are bioassays, such as the Microtox®, and enzyme-linked immunosorbent assays (ELISA). The first problem to address with using the Microtox® bioassay is the fact that mycotoxins are not soluble in water and must be extracted from grain in organic solvents. However, the Microtox® bioassay is an aqueous-based test and the presence of organic solvents can cause interferences. A solvent system is needed that is both effective at extracting the mycotoxins and which has no background toxicity, so that toxic responses can be linked to the mycotoxins, not to the solvent or to solvent interactions. In the present study, insufficient funds were allocated to perform in-depth research on the use of the Microtox® bioassay. However, an attempt was made to find the most suitable solvent system for use with this bioassay.

Various concentrations of the following solvents were tested for background toxicity to the bioluminescent bacteria used in the Microtox® test: acetonitrile (the most effective solvent for extracting mycotoxins from grain), acetone, methanol (commonly used in extracting mycotoxins from grain for ELISA testing), dimethyl formamide (DMF), and dimethyl sulfoxide (DMSO). After extensive testing, all of the solvents were considered to be too toxic for routine use in the Microtox® test. The order of toxicity was acetone$\geq$acetonitrile>DMF> methanol$\geq$DMSO. Solvent EC_{50}s ranged from 0.7 to 6.0% v/v. A solvent system with an EC_{50} >50% would be most suitable for use in the Microtox® test. Given the cost of Microtox® reagents, other studies could not be performed. Determining the suitability of using the Microtox® bioassay to screen grains for the presence of mycotoxins requires more research. The immediate drawback is finding a suitable solvent system for the extraction of the grains.

CHEMISTRY-SOILS

RESEARCH REPORTS

TITLE: **Iron Ochre Development in Subsurface Tile Drains**

LEADER: G. R. Brewster

OBJECTIVE: The primary objective of the continuing research into the problem of iron ochre clogging of subsurface drainage tile is to determine soil conditions and Fe(II) criteria which lead to "severe" ochre development. Research to date has shown a lack of correlation between "standard" soil characteristics and Fe(II)/bacterial concentrations which have caused clogging. Soil samples analyzed in Nova Scotia thus far have Fe(II) concentrations 10-100X greater than the 2.5 ppm "severe hazard" criteria cited in the literature.

PROGRESS:

A drainage contractor (LASER Drainage Co. Ltd.) provided information concerning areas where iron ochre build-up was suspected as being a problem. Samples were collected and analyzed with the aim of establishing relationships between dithionite-, oxalate-, and pyrophosphate-extractable forms of iron (Fe(III)) and Fe(II) values obtained from the field-test kit developed earlier. Although the development of the field-test kit has proven to be successful, there would appear to be no significant relationship between the various forms of Fe(II) measured by the kit and other more "standard" soil chemical parameters.

The net result arising from this lack of correlation is that the prediction of iron ochre hazard through the use of soil survey reports and other available soil data bases does not seem to be possible. Assessment of iron ochre hazard as it relates to tile installation would seem to be best assessed on a case-by-case basis through the use of the field test kit. Unless a more promising line of inquiry arises, research into this problem, and the development of spatially predictive maps and models seems to have come to a rather unsuccessful end.

TITLE: **Soil Erosion Determination Using Fallout Cs-137**

LEADER: G. R. Brewster

OBJECTIVE: To model rates of soil erosion and accumulation using fallout cesium-137 as a tracer. By drainage basin analysis, it is anticipated that soil erosion rates can be determined for a variety of soil types, slope conditions, and landuse practices. Once modelled, soil loss tolerances may be established for a variety of Atlantic Province situations both rapidly and accurately.

PROGRESS:

During the summer of 1990, soil samples were collected from a number of non-eroded reference sites to use as controls for the erosion research. These reference sites provided baseline data concerning the Cs-137 flux and depth distribution and also served as a form of calibration for the system (with reference to other research laboratories). The four control sites selected yielded a Cs-137 flux for the non-eroded, undisturbed condition of 3520 Bq/m^2. An example of the Cs-137 flux for one of these sites is presented on the following page (ONSLOW PASTURE).

In addition to calibration sampling, soil samples were collected from the farm of Mr. W. McCurdy (Bidalosy Farms) in the Old Barns/Clifton area of Colchester County. Samples were collected along two transects established in a field planted to corn. Samples were collected from the plough layer (Ap horizon) and the subsoil (Bm horizon) to determine Cs-137 flux for the site. Bulk densities of the topsoils and subsoil were determined by the core methods.

In a second field (planted to alfalfa), a 100 m by 80 m grid was established in order to enhance the two-dimensional linear transect model with three-dimensional erosion information. Determination of Cs-137 flux has been completed for the grid, but the data has yet to be fully analyzed. A model of the topographic situation of the grid is presented on the following page.

Data for transect #1 indicate that 67% of the sampling sites were representative of soil loss, with values ranging from 43 t/ha/yr to 103 t/ha/yr. On average, rates of soil erosion as determined by Cs-137 flux characteristics indicated a 2.0% topsoil loss per year for Transect #1. Transect #2 had 64% of its sampling sites indicating soils erosion, with soil loss values ranging from 8 t/ha/year to 90 t/ha/yr. Calculations based on eroded sites indicate that topsoil is being eroded at a rate of 1.4% per year at this transect.

There is no doubt that soil erosion is a severe problem at this particular field, however, the site is by no means representative of a "typical" situation found in Nova Scotia. The site was preselected as having severe erosion problems, and it is for this reason that values of soil loss so greatly exceed the 5-10 t/ha/yr losses considered to be "acceptable" rates of erosion. There is also some difficulty in transferring point data representing soil gains and losses to an overall three-dimensional model indicating soil gains or losses over an entire field. However, the figures presented below indicate that erosion does have a spatial pattern and that some form of micro-management for this particular field may be of great benefit to the farmer.

TITLE: **Color and Pigment Stability in Lowbush Blueberries**

LEADER: Dr. N.L. Crowe

OBJECTIVE: The objective of this study was to examine the color changes and pigment stability of Maritime lowbush blueberries when they are subjected to a variety of food grade acids.

PROGRESS:

Lowbush blueberries which had been previously frozen, were blended with various amounts of citric and tartaric acid, two acids used in food processing and formulation. A Hunter Labscan reflectance colorimeter was used to objectively measure and record any changes in color and hue of the blueberry slurries under both incandescent and fluorescent light conditions. The reflectance colorimeter gives three values: the L value is a measure of the lightness/darkness, the 'a' value is a measure of the red/green (+a/-a) of the product, and the 'b' value is a ratio of the yellow/blue (+b/-b) hue of the product.

The addition of small concentrations of citric acid (1 and 2%) to the blueberry slurries was accompanied by an increase in the amount of blue (decreasing 'b' value) that was detected using fluorescent light conditions. The opposite trend was observed at higher levels of citric acid (5%), where significantly less 'blueness' was detected than in the unacidified control. When the samples were viewed under incandescent light conditions, a decrease in the blue intensity (increased '+b' value) was recorded for both citric acid or tartaric acid.

The addition of both citric or tartaric acid (0-5%) resulted in a more intense darkness in the blueberry slurry (L value). As the addition of either citric acid or tartaric acid lowered to pH from 3.4 to 2.09, the 'a' value increased significantly indicating that the slurries had acquired a more intense red color.

To obtain a measure of color stability, the instrumental color measurements were repeated on the same slurries (4°C) after five days. There was a slight loss of blueness over the five days as seen by an increase in the 'b' value. There was a consistent increase in the intensity of the red for the higher acid concentrations (2, 3, and 5%). There were no statistically significant changes in the lightness/darkness of these blueberry samples over the five days.

These results indicate that the delicate pigment system of blueberries can be affected by the type, and amount, of food acid used in processing. The present data indicate that additional work would be useful in further elucidating these complex interactions.

TITLE: **Enzyme and Flavor Changes in Modified Atmosphere Packaged (MAP) Lettuce and Rutabaga**

LEADER: Dr. N.L. Crowe

OBJECTIVE: The effect of modified atmosphere packaging (MAP) on the enzymatic activity and flavor volatile production of several horticultural products was examined with the goal of further extending the use of this technology. Other quality attributes (color, pH) were also recorded.

PROGRESS:

In the first year of this two year project, methodology was successfully established for several analyses. A gas chromatographic method was established for fifteen of the most common respiratory volatiles. The newly acquired reflectance colorimeter was installed and appropriate sample container (composition, size), aperture, and sample preparation technique was determined. It was decided to perform all objective color readings using simulated fluorescent light as this will most closely approximate that used in retail situations. The polyphenoloxidase enzyme method was adapted from apples to lettuce and rutabaga which necessitated the incorporation of an additional centrifugation step. Preliminary studies indicated that the timing of the reagent addition must be standardized.

Once the methods were established, lettuce was shredded and packaged under three atmospheres: Treatment 1 (3% O_2, 5% CO_2, 92% N_2): Treatment 2 (2% O_2, 10% CO_2, 88% N_2); and Treatment 3 was air. Samples were stored at 4°C and replicates analyzed after 1, 4, 7 and 10 days.

Measurement of surface color parameters indicated that a noticeable darkening of the shredded lettuce occurred between day 7 and day 10 for all treatments. Although not visually apparent, there was a slight shift in color to a more yellow hue as evidenced by an increasing Hunter 'b' value.

Volatile analysis showed that samples packed under the second atmosphere had the most off-odor compounds (methyl acetate, butyl acetate, ethyl butyrate) present after 4 days of storage. After Day 10 all treatments exhibited an unacceptable odor and the gas chromatographic analysis indicated the presence of small amounts of ethanol.

The polyphenoloxidase activity decreased approximately linearly over the period studied for all three treatments. Further work is needed to indicate whether this is a result in a change in the concentration of enzyme or due to a progressive reduction in substrate level. This will be studied further in the second part of this investigation. The pH data collected failed to indicate any significant difference between the treatments over time.

TITLE: **Pheromonal Enhancement of Blueberry Pollination**

LEADER: Dr. Jeff Hoyle

OBJECTIVE: This project will result in methods of increased honeybee pollination of blueberries being available to local growers. This methodology will also be useful in other crops where bees are important pollinators. Higher crop yields and hence farm incomes should result from this work.

The objectives of this research are:

1. To study the effects of commercial and synthetic pheromonal preparations on the honeybee pollination of lowbush blueberries.

2. To study the effects of blueberry extracts and laboratory synthesized pheromone constituents on the pollination behaviour of the honeybee.

PROGRESS:

During the 1990 season, we established beehives and operated blueberry plots in Debert and Earltown. Randomized-complete block plots were treated with Beeline and BeeScent and a flower volatile (citral) with a total of 8 different treatments. Each treatment was replicated three times at each site. The efficacy of the treatments was determined by a series of foraging bee counts which were taken over a five-minute period, commencing at 10, 30, 60 and 240 minutes after plot treatment.

Blueberry harvesting was done by hand with rakes and during this process, each plot was rated according to plant density. Plot yields were in the range 4-9 kg for a 3x3 plot in Debert and 5-12 kg for a 5x5 plot.

Statistical analysis of bee counts indicated that attraction of honey bees and other pollinating insects can be significantly increased by the use of both the commercial attractants and citral. Statistical analysis of berry yields did not show significant differences between treated and untreated plots. This may be explained by the fact that during the 1990 season, blueberry bloom proceeded from 20-80% in only about 4 days and yields were exceptional throughout the study area. The short bloom period also prevented us from performing an additional series of experiments.

TITLE: **A Rapid Analysis for Agricultural Ethylene**

LEADER: Dr. Jeff Hoyle

OBJECTIVE: The rate of ethylene accumulation in tissue culture vessels during in vitro growth of plantlets is one of the major concerns for micropropagators. Monitoring levels of ethylene is also important during storage of fruits and vegetables since it has a significant impact on ripening processes. In addition, straw burning has recently been utilized for breaking dormancy in both bulbs and potatoes, which is believed to be caused by the generation of ethylene, amongst other gases.

The objectives of the research project were:

1. To develop a rapid and sensitive method for the analysis of ethylene using Fourier transform infra red spectrophotometry.

2. To test the applicability of this method for monitoring ethylene levels in straw smoke, fruit and vegetable storage areas and tissue culture vessels.

PROGRESS:

A very fast method has been developed for the analysis of ethylene from any source using a long pathlength gas cell attached to a FTIR spectrophotometer. The analysis may be performed in less than 10 minutes by a relatively inexperienced technician. The method requires about 10 litres of gas sample, which may be a drawback for some analyses but the sample is not destroyed during analysis and so can be returned for further use if necessary. The analytical method is very easy to use for concentrations of ethylene in the range 20-800 parts per million. This could be significantly widened by use of a longer pathlength gas cell.

The method is useful for analyzing the content of ethylene and other gases in straw smoke. This area warrants further study in collaboration with the Plant Science Department, NSAC. Analysis of ethylene in tissue culture vessels is not practical using the developed method, since the levels of ethylene present are too low. Ethylene in fruit and vegetable storage facilities has not been measured to date. It is expected that the levels will be too low for the present method to be useful.

TITLE: **Identification of Meat and Meat Products by Isoelectric Focusing**

LEADER: Dr. A. Robin Robinson

OBJECTIVE: To continue the identification of meat and meat products using isoelectric focusing. The expanded objectives of the project were: (a) to isolate DNA from domesticated animals and wildlife; (b) to establish an identity profile of species - specific markers using isoelectric focusing of DNA on polyacrylamide gels; (c) to determine if the method can be used to identify meat samples from different breeds within the same species.

PROGRESS: DNA was successfully isolated from beef and pork samples. The isolated DNA was subjected to isoelectric focusing on thin layer polyacrylamide gels in a linear pH gradient of 3.0 to 9.5. Adequate separation of the DNA was not achieved and the staining procedure used proved to be very difficult. The DNA was then cleaved into smaller fragments using various restriction enzymes and the resulting fragments were subjected to isoelectric focusing using several linear pH gradients. In all cases, adequate separation of the DNA fragments was not adequate for species identification.

In order to address the problem of meat adulteration, a procedure was developed for the separation and identification of the aqueous extractable proteins in beef, pork and veal. The water soluble proteins when run on a linear pH gradient of 3 to 9.5 yielded adequate separation for the identification of meat from all three species. In addition, the procedure was refined so that adulteration of any one species with another could be detected. For example, ground veal adulterated with pork (a common practice) could be detected even when the percentage of pork was as low as 4%. Beef samples adulterated with pork could also be detected when the pork content was approximately 5%.

Attached is an example of an isoelectric focusing gel showing how ground veal adulterated with ground pork can be detected (see pork/veal 1/1). Samples A1 through C7 were actual veal samples supplied by Consumer Corporate Affairs Canada which were suspected of being adulterated with pork. The results clearly show that only samples B2 and C4 were actually adulterated with pork.

The isoelectric focusing procedure has been applied successfully to a wide range of raw meat samples. Attempts to use the procedure for cooked meat samples has not proven to be successful and additional research in this area is required.

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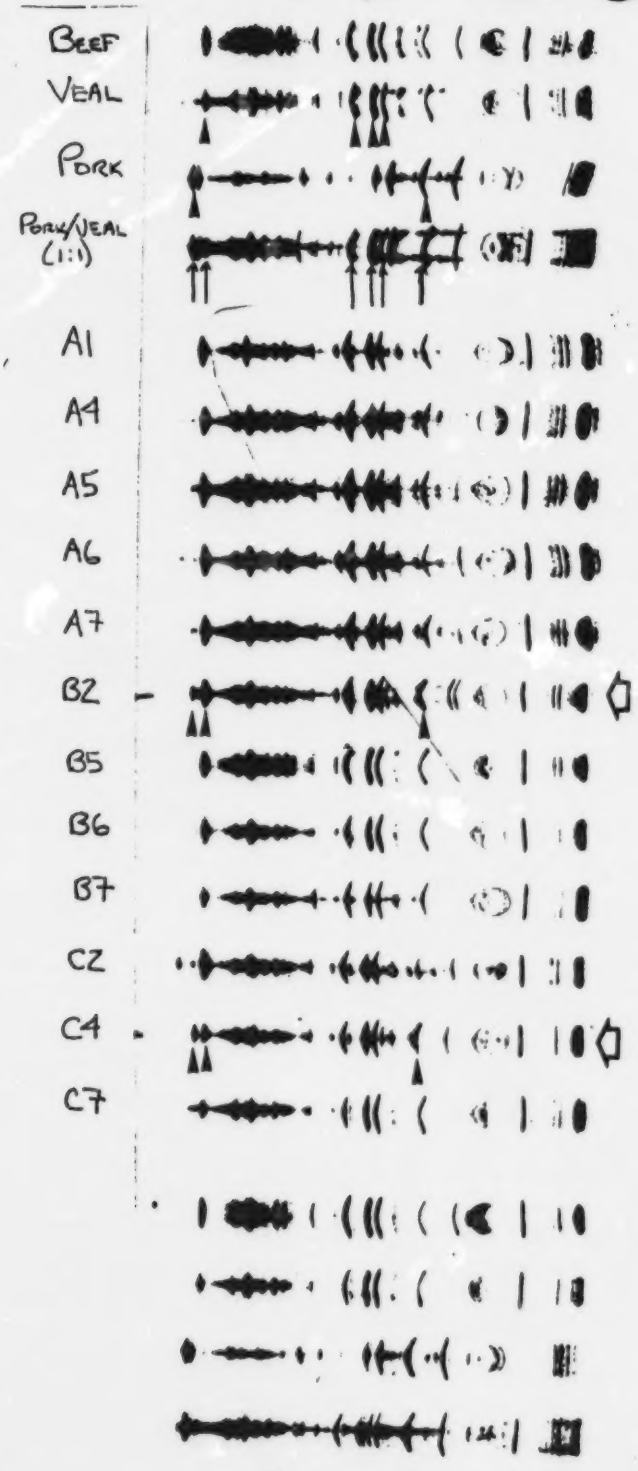

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ECONOMICS & BUSINESS

RESEARCH REPORTS

TITLE: **Management of Maritime Wheat Price Risk**

LEADER: K. Gary Grant

OBJECTIVE: To develop strategies for the management of the price risk confronting Maritime Wheat producers and the Nova Scotia Grain Marketing Board under the new system for pricing Canadian milling wheat.

PROGRESS:

This project was motivated by the May, 1990 change in the Canadian Wheat Board's (CWB's) pricing system for milling wheat. Instead of being fixed over two- and three-month periods, prices began to be changed weekly and later, daily, based on fluctuations in prices for nearby wheat futures on the Minneapolis Grain Exchange (MGE), converted to Canadian dollars.

After the project was begun, the methodological point that social scientists are generally precluded from conducting controlled experiments was reinforced as it became apparent that major revisions in safety net programs were being seriously considered. The recently-announced, tripartite Gross Revenue Insurance Plan (GRIP) melds price insurance and yield insurance in a single, voluntary plan.

Nova Scotian producers of spring-sown, milling wheat faced an enrolment deadline of April 30, 1991. To the extent that producers do enrol for the GRIP, the policy environment envisioned at the time of the project proposal will have changed substantially: the GRIP offers producers a target price calculated as an inflation-indexed, 15-year moving average.

In this new policy environment, the effectiveness of Nova Scotia Grain Marketing Board (NSGMB) hedging would depend on its integration with the GRIP. One alternative is separate NSGMB cash and futures accounts with GRIP support payments based on the cash account only. Another is combined cash and futures accounts with the benefits of the lower price risk achieved through hedging passed on in the form of lower premiums.

Regardless of how the integration might be achieved, the substantial database compiled last summer can be utilized in stimulating hedging strategies in a GRIP environment. In this compilation, priority was given to disaggregating the CWB cash - MGE futures basis into three components: first, the Minneapolis nearby futures - Duluth cash basis; second, the Duluth cash - Thunder Bay CWB cash basis, allegedly affected by differences in wheat quality; and third, the exchange rate. This database establishes an empirical foundation for the continuation of research on hedging strategies.

TITLE: **Multiple Component Pricing of Milk**

LEADER: K. Gary Grant

OBJECTIVE: To determine the impact of multiple component pricing of milk on Nova Scotia producers and processors.

PROGRESS:

Data have been compiled on fluid milk composition, by farm, for Nova Scotia from January to October, 1990. A sample from this database was utilized to simulate the impact of multiple component pricing (MCP).

Two assumptions were made in the simulations. First, pricing is based on at least two components: one plan is based on butterfat (BF) and protein (PR) and a second is based on butterfat and solids-not-fat (SNF), with and without class differentials. Secondly, the adoption of MCP was assumed to be revenue neutral in that the total revenue paid to producers is unaffected. However, there is a revenue impact on the individual producer to the extent that the farm's milk composition differs from the industry's average milk composition.

On the basis of the simulation results, inferences were made concerning the determinants of the distribution of the changes in producers revenue per hectolitre of milk.

The distribution is widened when pricing is based on protein rather than SNF. In addition to protein, SNF includes lactose and minerals, which vary little as milk components from one farm to the next; protein content varies more. Hence, a pricing system that places value on lactose and minerals as well as protein; that is, a BF-SNF system, has less impact than a BF-PR system.

Inclusion of class differentials lessens the distribution of the revenue changes arising from the adoption of MCP. A class differential places some value on milk, on a volume basis, simply for being milk. Hence, this part of the farmer's return is unaffected by milk composition.

The distribution of impact is also affected by the breed composition of the provincial dairy herd. In general, the coloured breeds have higher protein and SNF content in their milk. As their share of the provincial herd increases, the gap between provincial average milk composition and the typical Holstein herd's composition widens. Although Holstein operations continue to benefit from high milk yields, under a revenue-neutral MCP system, there is some reallocation of producers' revenue to the coloured breeds.

Presentations based on these simulations were made to dairy farmers in Kentville, Truro, and Port Hastings, to participants in NSAC's College Royal, and to the N.S. Dairy Commission's milk classification committee.

PLANT INDUSTRY

RESEARCH REPORTS

TITLE: **Cereal Row Spacing and Seeding Rate**

LEADER: Dwane R. Mellish

OBJECTIVE: To compare the response of spring wheat, 2 and 6 row barley at two row spacing (8 cm and 16 cm) at four seeding rates, utilizing field scale equipment.

PROGRESS:

Year two of this three-year project was completed with the co-operation of Robert Cooper, Great Village.

The project was conducted in accordance with the original plan except the highest seeding rates in the wide row spacing could not be accommodated by the seeder. This was also the case in 1989 and is a practical limitation of this practice.

The trial was seeded in early May with a field scale drill in replicated 3m x 10m plots.

A prolonged cold wet period after planting, followed by very dry soil conditions during grain fill, limited grain yields and potentially masked some of the treatment effects. Fungal disease pressure was low and controlled where necessary.

In all 3 species, narrow row spacing increased the number of plants/m^2 established, and heads/m^2. Increasing seeding rates at both row spacings increased the number of plants/m^2 established. The only significant difference in grain yield was in the spring wheat, where the 150 seeds/m^2 yielded significantly less than all other treatments. The lack of yield response was probably due to the relatively low yield levels (2 row barley$\sim$3.0/t/ha 6 row barley$\sim$4.0 t/ha, and spring wheat 3.0 t/ha) caused by the poor seasonal growing conditions.

The third and final year of this project will provide adequate information to give sound agronomic recommendations in this area of cereal production.

PLANT SCIENCE

RESEARCH REPORTS

TITLE: **Effect of Water Content of PNCM/Soil on Survival and Development of Bacterized (PGPR) Potato Plantlets**

LEADER: S.K.Asiedu

OBJECTIVE: To evaluate the effect of a pseudomonad plant growth promoting rhizobacteria (PGPR) on the survival and development of potato plantlets transplanted into polyethylene glycol (PEG) and soil and different moisture contents.

PROGRESS:

In vitro growth of bacterized (Pseudomonas sp. strain Ps-JN) and non-bacterized potato cultivar Kennebec in MS based potato nodal cutting medium (PNCM) amended with 0,5,10 and 15% polyethylene glycol (PEG8000) to vary the moisture content, was examined. Growth rates of Kennebec were significantly altered by increasing concentrations of PEG. At three weeks incubation, the bacterized plantlets developed on the average, 5,4 and 2 nodes while non-bacterized plantlets developed 2,2, and 1 nodes in the 5,10,15% PEG, respectively. In the non-amended controls there were at the 9 node stage. Growth retardation ranged from 38 to 75% in bacterized plantlets compared to 50 to 88% in the non-bacterized plantlets as the moisture content of the medium decreased.

Field Soil

The desired moisture contents were obtained by adding the appropriate volume of water to 1.3 kg of pasteurized dry field soil in 15 cm plastic pots. The soil moisture contents ≤50%, 50-75% and 100% field capacity corresponding to -0.08, -0.04 to -0.06 and -0.02 MPa respectively, were measured with gypsum block electrodes connected to Soil Moisture Tester (Model KS-1).

Four-week-old bacterized (strain Ps-JN) Kennebec and Desirée from MS based PNCM, were transplanted into the pots containing soil at various soil water contents. The pots were placed in a growth chamber with 16 hr photoperiod and 70-75% relative humidity.

The experiment was conducted as a factorial experiment in a randomized complete block design with four replicates. The factors consisted of two cultivars (Kennebec and Desirée), two inoculations (bacterized and non-bacterized plantlets), and three soil water contents (≤50%, 50-75% and 100% field capacity).

The survival of bacterized and non-bacterized plantlets of Kennebec and Desirée under three soil moisture contents is shown in Figure 1. Transplant survival was higher in the bacterized plantlets of Kennebec and Desirée in the soil moisture content at ≤50% and 50-75% field capacity than the non-bacterized controls.

Bacterization significantly improved plantlet survival when soil moisture was limited. At field capacity, there was no significant difference between the survival rates of the bacterized and non-bacterized potato plantlets. The bacterized plantlets were sturdier than the non-bacterized plantlets irrespective of the soil moisture content.

Bacterization increased leaf area of Kennebec by 40% while Desirée was not significantly affected. The bacterized plantlets had significant increase in root weights at soil moisture contents of ≤50% and 50-75% field capacity. The root dry weight of bacterized Kennebec was double that of the non-bacterized controls at the moisture levels below field capacity. Desirée responded to a lesser extent than Kennebec.

Shoot weights for bacterized plantlets increased up to 64% and 34% in Kennebec and Desirée respectively, at the range of moisture levels evaluated. The Pseudomonad strain Ps-JN improved survival and development of Kennebec and Desirée plantlets at moisture contents below field capacity.

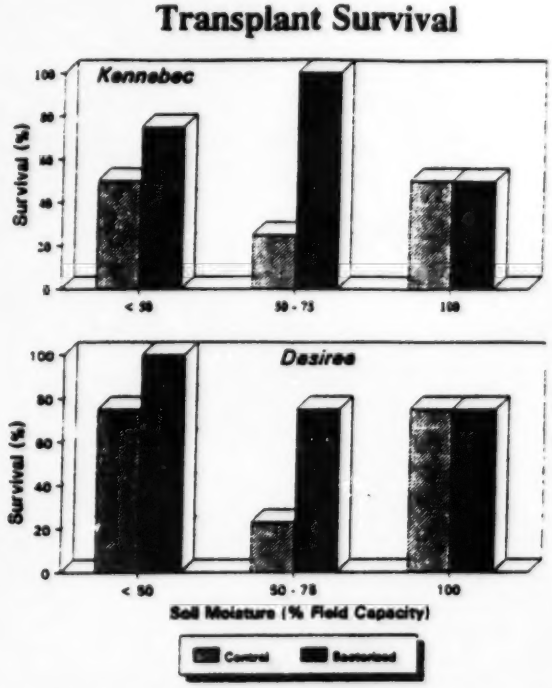

Figure 1: Mean survival of bacterized and non-bacterized potato cultivars transplanted under varying soil moisture content.

TITLE: **Postharvest Horticulture - Precooling, Storage and Shelf Life of Fruits and Vegetables**

LEADER: S.K. Asiedu

OBJECTIVE: Postharvest techniques which can successfully extend the useful life of fruits and vegetables are of great importance to industry. Rapid cooling treatments and proper storage conditions are essential to extending the shelf life of produce. The objectives of the project were:

(i) To evaluate the effect of pre-cooling and storage atmospheres on the shelf life of blueberries.

(ii) To determine the effect of the duration of controlled atmosphere storage on shelf life of blueberries.

(iii) To evaluate the effects of controlled atmosphere storage on the incidence of rot in blueberries.

(iv) To evaluate shelf life of three tomato cultivars.

PROGRESS:

Berries

The prolonged cool weather in the early part of the 1990 summer delayed the maturity of most horticultural crops, especially small fruits. Aspects of the 1989 work was repeated mainly for blueberries. Two cultivars, Fundy and Blomidon, were subjected to supercooling, forced air cooling, and controlled atmosphere storage conditions for periodic shelf life and quality assessment.

Blueberry cvs Fundy and Blomidon were supercooled at 0, -2.5 and 5°C and shelf life evaluated at bi-weekly intervals. The berries tolerated supercooling at -2.5°C. However, on exposure to shelf at 10°C, marketable weights were 34 and 40% for Blomidon and Fundy respectively, after 7 days. Berries supercooled at 0 or -5°C had a rather short shelf life and low quality. Shelf life was not extended when supercooled berries were stored for 2 weeks or longer. The shelf life of forced air pre-cooled blueberries stored under regular and controlled atmosphere storage was examined at 10°C and room temperature (21°).

The Fundy and Blomidon berries, precooled to 0°C prior to regular storage (0°) for two weeks, retained 87 and 89.5% marketable weight respectively when placed on the shelf at 10°C for up to 10 days. Fundy and Blomidon held at room shelf (21°C) retained 53 and 69% marketable weight respectively. Losses were associated with high incidence of Botrytis cinerea infection of berries and physiological breakdown. Relative to artificially inoculated samples, the natural Botrytis infections were also high.

Changes in total soluble solids in marketable berries ranged from 0.1 to 1.5% for shelf temperature 10°C while at shelf temperature 21°C, the range was 1.8 to 3%.

Precooled Fundy and Blomidon berries stored in controlled atmospheres containing 0, 5 and 15% CO_2 and 1, 2 and 5% 0_2 combinations, were evaluated bi-weekly for shelf life and quality at 10° and 21°C. Berries artificially inoculated with Botrytis cinerea and stored in similar conditions were also evaluated.

The two cultivars tolerated low 0_2 levels to 1%. Berries stored for two weeks in controlled atmospheres containing 5-10% CO_2 and 1-2% 0_2 retained up to 80% marketable weight after 10 days shelf holding at 10°C. Similar samples held at 21°C retained 18-30% marketable weight after only 7 days. Both naturally and artificially inoculated samples held at room temperature showed high incidence of botrytis rot.

The shelf life quality of berries declined considerably at all levels of controlled atmosphere storage after four weeks. The 10-day shelf exposure retained 30-50% marketable weight at 10°C. At room temperature shelf exposure, severe rot and physiological breakdown occurred in 48 hours.

Total soluble solid content did not change significantly at 10°C temperature. Six weeks of storage of the berries in both regular and CA storage was not feasible due to severe physiological and pathological breakdown.

Tomatoes

In a preliminary study, three cultivars - Long Keeper, Barpee's Long Keeper and Basket Vee, grown at N.S.A.C. Plumdale plots, were evaluated for keeping quality. At room temperature, Long Keeper and Barpee's Long Keeper placed in brown paper bags, retained texture (firmness) for up to 6 weeks. Losses were estimated at 40% due to Alternaria rot. The samples retained beyond six weeks and high shrinkage and decay. Future work will include postharvest treatments to eliminate pathogens and use of low temperature storage to extend shelf life.

TITLE: **Winter Wheat Cultivar Development**

LEADER: G.N. Atlin

OBJECTIVE: To select winter milling wheat cultivars suitable for production in Nova Scotia

PROGRESS:

In the first year of this program, germplasm was assembled and field screening initiated. Approximately 700 F_2 and F_3 heads and single-plant progenies were selected in the Agriculture Canada, Charlottetown winter wheat nursery. These lines were derived from crosses among bread-quality cultivars, and between bread-quality cultivars and feed-quality lines with outstanding agronomic characteristics. Approximately 300 lines are being evaluated in replicated nurseries at Truro, Canning, and Nappan in the 1990-91 growing season. The remainder are being evaluated in a conventional headrow nursery in Truro.

Differential winter survival was observed at all sites. Hardy, agronomically acceptable lines will be selected after harvest in August, 1991 and will be screened for bread-making quality. Acceptable lines will be replanted in replicated yield trials in 1991-92.

A program of crossing winter-hardy, lodging-resistant feed-quality wheats with bread-quality lines was also begun in 1990. F_1 plants are now being vernalized, and will be transplanted to the field in June of 1991.

Methodological research aimed at determining the effectiveness of microplot selection for agronomic traits was also initiated. Preliminary indications are that microplots can be used to screen breeding materials for winterhardiness.

TITLE: **Cereal and Protein Crops**

LEADER: J. S. Bubar

OBJECTIVE: To support the breeding programs aimed at developing grains crops for the Atlantic Region. To evaluate cultivars for recommendation and licensing. To support other research and development projects by carrying out other small plot trials that are requested by Atlantic Advisory Committee members.

PROGRESS:

Details on individual trials appear in regional data compilations.

We were fortunate to get our spring seeded cereals established early in spite of weather problems that led to seeding delays on farms in the area. Having the Boulden field available for these trials is an important factor in our being able to carry out these trials during the period that summer student assistance is available. We had little winterkill with the winter cereals. For the first time in several years, we did not have to use bird control to avoid damage to plots.

Trials conducted in 1990 were:

1. Eastern Registration Oat Test which was conducted at 14 locations in Eastern Canada. We had the 3rd highest average yields, a low c.v. and very little disease.

2. Maritime Winter Wheat Registration test - we had the lowest c.v. (5.3%) among the five sites harvested. An average yield of 6.5 tonnes/ha under intensive management was second to the 8.0 tonnes obtained at Woodside. There was good agreement in the ranking of entries at the three intensively managed sites.

3. Maritime Co-op 2-row Barley Test conducted at four sites - we had the highest average yield. Our c.v. was 9.6% and the data is consistent with other trials.

4. Maritime Co-op 6-row Barley test - we again had the highest average yield among the four sites. Our c.v. of 10.9% is accepted.

5. Maritime Co-op Spring Wheat Screening test at four Maritime plus two Quebec sites. We had the highest average yield and the lowest c.v. among the six sites.

6. Maritime Co-op Winter Wheat Screening test - our trials and the one at Woodside survived; the one at Charlottetown winterkilled. We again had a good average yield of 6.6 tonnes/ha and a low c.v. of 4.8%.

Reports on the following trials had not been received by February 1, 1991.

7. Eastern Bread Spring Wheat Trial

8. Regional short season soybean co-op trial - we had less obvious variability than in the previous year, which suggests our seeding technique has improved, but it still does not measure up to the technical quality of our cereal trials.

9. Lupin variety trial.

10. Canola variety trial - we got better seed distribution than in the previous year by improving the technique for loading the cone seeder and believe the analyzed results will demonstrate that we have a very good trial.

TITLE: **Forage Crops**

LEADER: J.S. Bubar

OBJECTIVE: Evaluation for cultivar registration and recommendation and for development of breeding materials as required for co-operative evaluation and breeding projects co-ordinated by the Forage Evaluators sub-committee and by the N-E. 144 project.

PROGRESS:

Details on individual trials are being combined with those from other co-operators and will appear in the 1990 Forage Evaluators report.

Alfalfa. Data were collected from trials seeded in 1987, 1988 and 1989 (2 trials). Stands on all trials were irregular which considerably reduced the value of the data obtained and made it difficult to demonstrate statistically significant differences. We are having difficulty developing good conditions for alfalfa trials on the Sutherland property. Attempts to bed the area to reduce damage from ice on the surface may have caused soil fertility irregularities. We have applied treatments in 1990 which we hope will improve performance in 1991. One new row trial of breeder material was established in 1990 as well as a small trial in the Plumdale field.

Timothy. Trials established in 1987 and in 1988 were harvested in 1990. Differences between entries are difficult to demonstrate as far as yield is concerned.

Fescue and Fescue X Ryegrass hybreds. A trial established at the Sutherland property in 1989 was harvested in 1990. Results have not yet been received from the co-ordinator. This trial looked as if it will provide good data.

Red Clover. A new trial was established at Plumdale in 1990. It established well and should provide good data in 1991.

TITLE: **Turfgrass Cultivar and Management Evaluations**

LEADER: R. W. Daniels

OBJECTIVE: To evaluate the latest cultivars and management techniques as they relate to turfgrass production in this region.

PROGRESS:

Establishment of Turf-type Tall Fescue and Kentucky Bluegrass Mixtures.

Four dwarf, turf-type tall fescue were established in the spring of 1989. Cultivars used were Maverick, Mustang, Rebel and Thoroughbred. Each was sown at a seeding rate of 2.4 kg/100 sq.m. They were established with 10 percent dwarf-type improved Kentucky bluegrass cultivars (Bronco and Nassau) to provide for a more dense turf sward at maturity. They were fertilized throughout the season at three separate times with 0.5 kg N/100 sq.m. Plots were maintained at the two cutting heights of 1.8 and 3.0 cms.

Cultivars Thoroughbred and Rebel, planted with either Kentucky bluegrass and at both cutting heights, had and maintained between 95 and 100% ground cover throughout the growing season. Cultivars Mustang and Maverick, with identical mowing tratments, had ground cover readings of 80 to 90%. The lowest readings were obtained from those plots mowed at 1.8 cm. The least ground cover was in those plots containing no Kentucky bluegrass.

Late Season Fertilization of Turfgrass

Two turf-type (controlled release) fertilizers were evaluated as to their seasonal ability to provide adequate fertility to turf. Fertilizers used were SCU 25-4-10 and Scotts (UF) 37-3-3. Twelve treatments of each fertilizer were used. Total seasonal nitrogen applications ranged from 0.50 to 1.25 kg.N/100 sq. M. Plots were rated from 1 to 10 with 10 being the best possible colour.

September only treatments of fertilizer resulted in the lowest colour ratings the following spring. The combination of September and November fertilizations gave the best spring ratings the following year. This result was at its maximum when the November application rate of N was 0.5 kg.

TITLE: **Using Digital Image Analysis to Measure Adipocyte Cellularity**

LEADER: A. Farid

OBJECTIVE: To develop the methodology of using digital image analysis techniques for sizing and counting adipocytes in ruminants.

INTRODUCTION: In ruminants, the adipocyte is the major site of fat synthesis. Fat accumulation in ruminants occurs via hyperplasia (increase in cell number) and hypertrophy (increase in cell size). Measuring the size and number of adipocytes, and assessing the effects of genetic and environmental factors on these attributes will be beneficial for both selection plans to reduce body fat in meat animals and for appropriate nutritional recommendations in cattle and sheep. Digital image analysis is a valuable technique in terms of accuracy, reliability and speed when dealing with large number of number of measurements, such as adipocytes.

PROGRESS:

Fresh lamb and calf fat samples were obtained from the abattoir and transferred to the laboratory in 0.9% NaCl at 37°C. Around 100 mg of fat tissue was sliced into 0.5mm thick layers using a microtome. Tissues were rinsed three times in 0.9% NaCl at 37°C and fixed for 96 hr in 1.88% osmium tetroxide (50 mM collidine buffer, pH 7.1). The osmium solution was removed, samples were washed twice, 8M urea was added to dissolve connective tissue, the samples were then washed through 0.25 mm and 0.01 mm mesh nylon filters, and were suspended in 0.01% Triton X-100.

Osmium tetroxide-fixed adipocytes were magnified 60 times, photographed (Fig. 1) and their dimensions and area were measured by callipers and compensatory polar planimeter, respectively. This approach was found to be very time consuming and not very accurate, mainly because adipocytes are not truly circular (Fig.1). Similar measurements were taken from a videotape of adipocytes by a digital image analysis system. Although the process was much faster than using mechanical tools, the accuracy of both methods was comparable.

Image analysis was used to measure density, total pixels, shape factor and perimeter of the cells. The threshold feature of the system was used to determine the number of pixels that fall within a given threshold or brightness level. Since the cells have approximately similar brightness level, the number of pixels per cell was computed by dividing the total number of pixels in a given area by the number of cells. This approach was used to compute number of pixels/mm^2 and then cell surface area. It was found that this feature increased the speed of measurement and reduced errors compared with using mechanical tools. All the measurements taken with image analysis were automatically recorded and the necessary calculations were programmed into the system.

Averages of the measurements taken on a sample of fat from lamb kidney fat were: Length 76.2 micron, width 50.6 micron, perimeter 0.2033 mm and area 0.00297 mm^2. These values agree

with the corresponding estimates reported in the literature.

Fig. 1 Photomicrograph of osmium tetroxide-fixed lamb adipose cells (X60). Distance between grids in the inset scale is 50 micron (0.050 mm).

Conclusions: Digital image analysis was found to be much faster than using mechanical tools for sizing adipocytes. The system was particularly helpful for take measurements such as area and perimeter, which are essential in characterization of adipocytes.

TITLE: **Wire Basket Injury to Roots of Transplanted Trees**

LEADER: C.D. Goodwin

OBJECTIVE: To assess the implications of girdling wire injury to the establishment and performance of shade trees, and compare the growth of trees transplanted bare root to trees transplanted in wire basket containers.

PROGRESS:

Thirty Glenleven linden trees (45 mm trunk caliper) were planted in early November in the field at the Plumdale research farm. Fifteen trees were planted with the wire basket intact, and the basket was removed at planting time on the remaining 15 trees. The trees were fertilized and mulched in May, 1991. Analyses of foliar levels of P, K, Ca and Mg and root carbohydrate content will be carried out in 1991, as well as measurement of truck caliper increase, twig extension growth, foliage dry weight and photosynthetic activity.

TITLE: **Vegetable Trials - Black Plastic Mulch and Row Two Field Covers on the Growth of Green Peppers**

LEADER: T. H. Haliburton

OBJECTIVE: To compare the effect on yield of sweet green peppers provided by the plastic field covers Agronet and Agplast; to determine the effect of plastic mulch in combination with field covers; to determine if cultivars react differently.

PROGRESS:

Previous NSDAM Research funded trials have demonstrated that plastics have potential to enhance yields of "heat loving" crops; to increase earliness of many vegetable crops; to reduce the propensity to bolting of specific vegetable crops. It is well accepted that plastic films increase soil temperature, improving growth of plants early in the season and speeding mineralization of soil organic matter, thereby theoretically reducing the need for added fertilizers. Plastic mulches are also thought to reduce leaching, conserve moisture, prevent bird predation of seedlings, provide a barrier to egg laying insects, and eliminate weed growth.

In the summer of 1990, six varieties (Lincoln Bell, Staddon's Select, Niagara Giant, Midway, Jupiter Elite, and Yolo Wonder) were compared under two kinds of field covers (Agronet and Agplast), with or without black polyethylene mulch, at the Plumdale research facility. Design was a quadruplicated split-split plot design with field covers the main plot,mulch the sub plots, and varieties the sub-sub plots.

Agronet gave increased number and yield of peppers; so did black plastic mulch. This advantage was even greater when they were combined, as shown by a significant covers vs mulch interaction. Agplast polyethylene field cover gave lower yields than the checks, suggesting that temperature is a factor, and that more information on timing of removal of cover is needed. There was no interaction between varieties and plastics. Variety yields and fruit numbers were in the order in the above paragraph. Lincoln Bell was significantly better than all other varieties; Staddon's Select and Early Niagara Giant were significantly superior to Yolo Wonder.

TITLE: **American Ginseng Production in Nova Scotia**

LEADER: H.-Y. Ju

OBJECTIVE: To demonstrate the feasibility of commercially cultivating American Ginseng in Nova Scotia.

PROGRESS:

Spent compost from the oyster mushroom culture was used as an organic amendment in three beds at Plumdale prior to seeding on October 11, 2990. Since seedlings will appear this spring, the results will be evaluated later this summer, 1991. Organic matter content before adding the spent compost was about 5%.

Organic matter influences not only the supply of plant nutrients in a soil but its structure. However, soils which have higher organic levels that are near 8% or higher are not recommended for ginseng culture due to the possibility of poor drainage.

Shading material evaluation:

The woven black propylene has been evaluated as compared to wooden lath as an artificial shade. However, the woven black propylene cover required more labour to remove before winter and to recover the frame in the spring.

Mulching material evaluation:

Softwood sawdust mulches produced less weeds than straw mulches. Barley straws are commonly used at the Nova Scotia Agricultural College. Ginseng plots were covered with 4" barley straw. Mulching is very important because mulching material protects roots and crowns from cold injury and conserves moisture in the soil which protects seeds or roots from injury by dehydration during the winter months. Mulching materials conserve moisture content in soil which is important for seed germination in the spring.

TITLE: **Effects of Plant Growth Regulators on Fruit Set and Yield of Lowbush Blueberry**

LEADER: H.-Y. Ju

OBJECTIVE: To study the feasibility of GA_3 + NAA application in commercially grown lowbush blueberry crop. To find the best time of application for GA_3 + NAA.

PROGRESS:

A mixture of GA_3 and NAA was applied to Chignecto blueberry plants at the rate of 100 ppm and 0.5 ppm respectively. The times of application of the GA_3 + NAA were prebloom, postbloom, full bloom and no spray. The prebloom spray was applied on May 28, 1990, full bloom on June 8, 1990 and postbloom on June 26, 1990. The experiment was also divided into an uncovered plot allowing for insect pollination and a covered plot to prevent insect pollination.

The number of flowers produced by the plants was recorded in May, 1990, number of berries harvested on August 1, and the weight of the berries and number of seeds per berry were recorded for each treatment. The results indicate that a full bloom spray of GA_3 + NAA had the greatest number of set fruit with the highest yield (g) and number of seeds per fruit on the plots which were accessible to insect pollination. This was slightly higher in yield than the uncovered plots with no spray. The full bloom application of GA_3 + NAA on the covered plots had a much higher yield (g) than any of the other treatments in which insect pollination was prevented. The weight yield from the full bloom sprayed treatments (covered and uncovered) were comparable to themselves and to the uncovered no spray treatment. The number of berries formed was lower in the covered full bloom spray treatment. The lowest yield and number of fruit was noticed in postbloom and prebloom applications of GA_3 + NAA.

Covered Treatment	Fruit set (%)	g/berry	Number of seed/berry
No Spray	0.7	0.16	4.8
Prebloom	5.0	0.17	3.9
Full bloom	24.3	0.22	8.6
Postbloom	0.0	0.00	0.0

Uncovered	Fruit set (%)	g/berry	Number of seed/berry
No Spray	15.0	0.27	20.3
Prebloom	7.3	0.32	9.2
Full bloom	17.0	0.30	26.0
Postbloom	10.6	0.18	13.9

TITLE: **Alternative Methods of Seedless Cucumber Production**

LEADER: L.R. Mapplebeck

OBJECTIVE: This study examined the yield potential of 12 cultivars of seedless cucumbers grown in sawdust bags using a multiple cropping production system.

PROGRESS:

Twelve greenhouse cucumber cultivars were grown in bags of sawdust. Plants were fertilized through the irrigation system. Plants were grown at a density of 3.7 plants per m^2 and were cropped only on the main stem. Three crops were grown during the season with transplanting dates (into the sawdust bags) of March 11, June 11, and August 14. The harvest periods were April 23 to June 11, July 9 to August 14 and September 14 to October 10, respectively. Yield parameters included number of fruit and grade category. One half of the total season's production was obtained from the first crop (49%) with the second and third crop contributing 34 and 17%, respectively. The highest yielding cultivars were Mustang, Carmen and Superator (Table 1). Superator, however, produced a very large % of its yield in the small category. Mustang and Carmen produced 66 and 72%, respectively of their yield in the medium and large categories.

Table 1. Yield and grade categories of 12 cultivars of seedless cucumbers[1]

	Yield (fruit/m^2)		Grade Category (% of Total Yield)				
Cultivar	Total	Marketable	Small	Med.	Lg.	Ex.lg.	Cull
Mustang	60	54	25	57	9	0	9
Carmen	55	51	19	51	21	1	8
Superator	54	46	38	35	12	2	13
Nun6228	49	45	25	52	13	1	9
Sandra	47	43	25	48	15	3	9
Manu	45	43	25	62	8	1	4
Farbio	45	41	24	49	16	0	11
Corona	43	40	18	50	21	1	10
Super Sandra	42	40	19	59	14	3	5
Sofia	40	39	4	63	24	1	8
Sricia	40	36	40	48	3	1	8
Radja	38	34	10	60	17	3	10

[1]combined totals of 3 crops

TITLE: **Poinsettia Production Problems**

LEADER: L.R. Mapplebeck

OBJECTIVE: This study was initiated to examine the effect of transplant date, pinch date and other factors on the performance of 4 poinsettia cultivars

PROGRESS:

Poinsettia cultivars Annette Hegg "Dark Red" and Annette Hegg "Hot Pink" have been grown for many years. Cultural requirements and problems are well understood. Recently, there have been a number of newer poinsettia introductions including two red cultivars, Regal Velvet and Lilo. Regal Velvet tends to produce fewer breaks (side branches) than "Dark Red" and "Hot Pink" when grown as a conventional pinched crop, resulting in an inferior product. Lilo also produces fewer breaks than "Dark Red" and "Hot Pink" but reportedly produces more breaks than Regal Velvet and therefore has the greater chance of becoming an important commercial variety.

A number of experiments were initiated in August, 1990 to compare the 4 above-mentioned cultivars. In the first experiment, the 4 poinsettia cultivars were planted into 15 cm standard pots containing Pro Mix BX with 1 plant per pot on two different transplant dates, August 3 and August 22. Plants were then pinched at 2 different times, either 14 or 24 days after transplanting (August 17 and 27, and September 4 and 14, respectively). Plants were not given a growth retardant application. Parameters recorded included: # flowers (breaks), bract (flower) area, leaf area, fresh weight of total plant (excluding roots), plant height, and a visual rating value. Pinch date did not affect any of the measured parameters. Planting date did not affect the # flowers per plant; however, all other parameters were affected. Plants transplanted on the earlier date were taller and had approximately twice the bract area, leaf area, and fresh weight of those plants transplanted on the later date. Plants transplanted on the earlier date also had an average approximately 40% higher visual rating scores. There were no differences in heights of the 4 cultivars. Flower numbers, bract areas, leaf areas and plant weights did, however, vary between cultivars.Regal Velvet produced the poorest quality plants with an average of only 3.0 flowers per plant. "Hot Pink" and "Dark Red" produced 5.4 and 5.1 flowers per plan, respectively. Lilo produced 4.2 flowers per plant. Lilo's flowers were larger than the other cultivars and bract area, leaf area, plant weight and the visual rating value of this cultivar were similar to those for "Dark Red" and "Hot Pink".

In a second experiment, the four cultivars were again transplanted on the 2 different dates and plants were either left untreated or treated with 3000 ppm drench of the growth retardant Cycocel when new breaks, following pinch, were at the 2.5 to 5.0 cm stage of growth. Although plants treated with the growth retardant had smaller bract areas, weighed less, had smaller leaf areas and were shorter, none of these differences were significant.

A third experiment examined the 4 poinsettia cultivars grown as 2 pinched plants per 15 cm standard pot. Plants were transplanted on the same 2 dates as described above and pinched at 3 different times following transplanting (14, 19 and 24 days). Plant height and # flowers per

pot (2 plants) were recorded. Neither transplant date nor pinch date influenced flower number. Regal Velvet again produced the fewest number of flowers (2.6 per plant) with "Dark Red" producing 5.4. Lilo produced 3.8 flowers per plant. There was no difference in plant height of any of the cultivars. Shorter plants were produced from the latter transplant date.

A fourth experiment compared the 4 poinsettia cultivars when grown as 1 or 2 pinched plants per 15 cm standard pot. In this experiment, a graphical tracking window was established and plants were subjected to 2 drench applications of Cycocel at 1500 ppm in order to keep the plant height in the "window". Growing temperature was not manipulated for height control since the poinsettias were growing in a greenhouse which contained other trials and projects. The desired height window at the marketable stage was 35.6 to 40.6 cm. Regal Velvet, "Dark Red" and "Hot Pink" fell within this window. Lilo's final height was 4 cm shorter than the minimum desired. The second Cycocel application should not have been applied to this cultivar.

In summary, the cultivars Lilo and Regal Velvet differ when compared to "Dark Red" and "Hot Pink". However, Lilo rates very favourably with "Dark Red"; Regal Velvet in contrast produces an inferior product.

TITLE: **Somatic Embryogenesis in Red Clover**

LEADER: Jerzy Nowak

OBJECTIVE: To study the inheritance of in vitro regeneration in red clover and to produce regenerative red clover seed populations for use by plant breeders.

PROGRESS:

Improvement of crops via biotechnological methods usually requires regeneration of plants from cultured cells or tissues. The frequency of genotypes with regenerative ability in red clover is very low. A program was initiated at N.S.A.C. to select regenerative genotypes and to study the process and inheritance of the regeneration trait.

A red clover genotype with high regeneration capacity was selected. This genotype (F49R) was crossed to non-regenerative genotypes and the F1 progeny were evaluated. To date, approximately 30 percent of the F1 progeny regenerated plantlets from petiole callus.

During the past year, six regenerative and five non-regenerative F1 plants were backcrossed to the regenerative parent. Resulting seeds were surface sterilized and germinated in vitro. 243 BC1 seedlings were evaluated. The frequency of regenerative genotypes was 71 percent with regenerative F1 parents and 59 percent with non-regenerative F1 parents. Regenerative ability was not affected by seedling vigor. The six regenerative and five non-regenerative plants were also crossed in all combinations to produce an F2 population. 356 seedlings were evaluated. Crosses between two regenerative F1 plants resulted in the highest frequency of regenerating explants (69 percent), while crosses between two non-regenerative F1's produced the lowest frequency (11 percent regenerating explants) and crosses between regenerative and non-regenerative F1 plants yielded an intermediate response (39 percent regenerating explants).

Twenty-eight regenerative BC1 plants were acclimated in the greenhouse and were test-crossed to non-regenerative plants. Seeds have been collected and will be evaluated for regeneration during the summer of 1991.

Light and transmission electron microscopy of regenerative and non-regenerative callus tissue revealed that regeneration occurred via embryogenesis although some organogenesis was also observed. Indirect primary embryogenesis occurred from F49R callus tissue, while subsequent direct secondary embryogenesis occurred from previously regenerated structures. Callus cells of the non-regenerative tissues contained enormous deposits of phytoferritin in plastids. No phytoferritin was detected in regenerative tissues. We plan to further investigate the relationship between regeneration and phytoferritin.